Motor Control and Protection using Hybrid Network

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ABSTRACT
Mobile communication has proved to be few of glorious inventions made by Man-kind. But as science has no limitations, let us make the use of mobile communication not just to have a talk, but to operate remote appliances on walk. In this paper, our proposed idea controls multiple motors using single GSM from anywhere in the world. For this purpose user can use any type of mobile. This way it overcomes the limited range of infrared and radio remote controls. Using the convenience of SMS, this project lets you remotely control equipment by sending text messages. Here a hybrid approach is used to monitor and control the motors in the farms. In the wired communication RS485 mod-bus and in the wireless mode SIM300 MODEM is used to form hybrid network. RS485 mod bus is a widely used and accepted communication system in the industrial world as it is reliable and cheaper.

Keywords
Short Message Service (SMS), Global Systems for Mobile Communication (GSM), Micro processor laboratory (MPLAB), Peripheral interface controller (PIC), Integrated Development Environment (IDE)

1. INTRODUCTION
Now-a-days power utilization is more than power generation, in such a way electricity is unreliable and mostly available at odd times. So, in these situations it is hard for the farmers to switch pumps and monitor their farms frequently. Since the farmer and their farms are located in different places it is difficult for the farmers to water their farms during odd times. There may exist hazardous conditions near the water pump area and also one person per shift has been dedicated their work with vehicle. Modern electronics paves a way for wireless technology in which we can monitor and transfer the information about present status of the farm which makes the monitoring work easier. Once any critical situation occurs it again adds the risk of manual control. Many new techniques are introduced, such as control of three phase induction motor [1], cell phone based control of pump using call based technique [2],voice acknowledgement [4] and so on, have been integrated into motor monitoring and control [5]. The main drawbacks in these systems are there may be a change of collision of messages and cannot be able to control multiple motors by using single GSM. In order to avoid wastage of man power, fuel, electricity, time, cost we are proposing a system which overcome all the above mentioned drawbacks. Using the convenience of SMS, this project lets you remotely control multiple motors by sending plain text messages, such as "motor1", "motor3","motor42"– all of which can be pre-programmed into the controller. Short Message Service (SMS) is a text-based service that enables up to 160 characters to be sent from one mobile phone to another. Unlike voice calls, SMS messages travel over the mobile network‘s low-speed control channel. "Texting" is one of the fast and convenient ways of communicating. In fact, SMS has taken on a life of its own, spawning a whole new short hand language that‘s rapidly many industries have been quick to make use of this technology, with millions of handsets currently in use. As new models with "must have" features hit the market, older models become virtually worthless and if not recycled, end up in landfill. With this in mind, we‘ve designed the project to work with sim300 GSM modem with SIMCOM technology.

2. SYSTEM COMMUNICATION ARCHITECTURE
As shown in Figure 1 the wireless transference of motor monitoring messages discussed in this paper is built on the SMS of the GSM network. Data messages produced at one end of the monitoring system are encapsulated into a short message and sent to master board at another end. When a short message is received, it can check whether it is an authenticated user and restored to its original industrial form. The message can be forwarded into appropriate slave board where the motor is placed. The system makes use of mod bus protocol to deliver messages to appropriate slave board. This system is not only controlling and also monitoring the status of multiple motors by using single GSM on the user side.

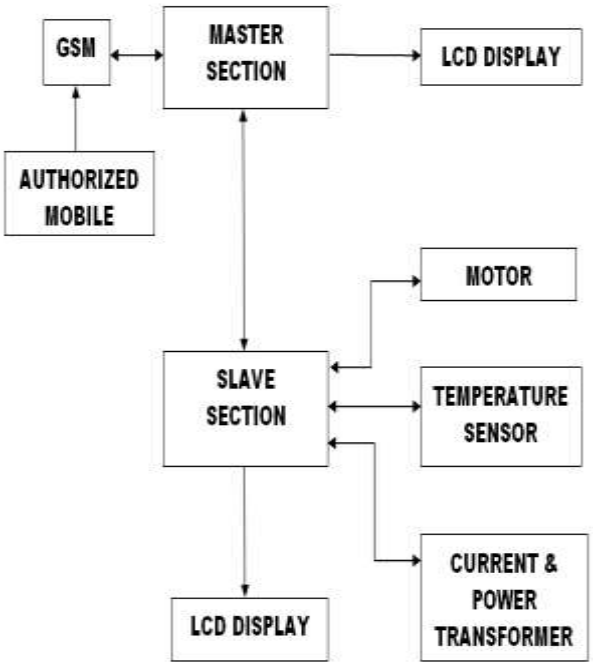

Fig 1: System Communication Architecture

3. WORKING

In this project we are using GSM technology and microcontrollers (PIC) which consist of supporting features such as A/D converter, timers etc. The LCD displays the current status of a motor. Major role of this system is to receive the SMS from user to know the status of motors and switching the motors by using single GSM on the user side.

Initially the SMS is received from person authorized to use this setup by the GSM modem (SIM300 MODEM) and is transferred to the master board where the microcontroller is placed with the help of MAX232 chip. The message serves as commands. After receiving the commands the master board extracts the message from the GSM and transfers the control to the appropriate slave boards (a program for extracting the control signal part from received SMS is loaded into microcontroller) this transfer happens through mod-bus protocol. Then the microcontroller which is placed in the slave board tries to read SMS which is received from master board in order to control the motors. The status of the motor will be given back to the user through the GSM in the master board. Before implementing the control signal part of the SMS, the controller in the master board verifies if this number has to have the access to control the motors or not. For controlling the devices the message will be send in a hexadecimal format. The hex data is converted to the equivalent binary to enabling the ports in the microcontroller.

4. COMPONENTS USED

- Microcontroller - PIC16F887A
- Modbus Protocol - SN74HC04
- Sim 300modem
- LCD - 16×2-LM016L
- Voltage regulator - IC 7805
- Transformer (230v-12v)
- Current transformer (25A-1v)
- RS 232 converter: AX 232
- GSM
- Temperature Sensor: LM35

5. A BRIEF INTRODUCTION OF GSM SIM 300MODEM WITH SIMCOM TECHNOLOGY

GSM modem with RS 232 connector: The Global System for Mobile Communications (GSM**)** is the most popular standard for mobile phones in the world. It is the European standard for digital cellular service that includes enhanced features. It is based on TDMA technology and is used on 900/1900 MHz we are using the SIM 300, a GSM modem from SIMCOM. This is a powerful GSM/GPRS terminal with compact and self-contained unit. This has standard connector interfaces and has an integral SIM card reader. The modem has aRJ9 connector through which a speaker and microphone can be connected allowing audio calls being established, but this feature is not utilized in this project as only data transfer is needed. Following are few technical details of the modem.

5.1. Interfaces

- TTL Tx, Rx , VCC , GND
- Serial port baud rate adjustable 1200 to115200 bps (9600 default)
- BRK connector for MIC & SPK, SIM card holder
- LED status of GSM / GPRS module

5.2. Features

- Data: RS232 9–way (V.28)
- Audio 4-wire Handset Interface (RJ9)
- Antenna: 50_ (FME male)
- GSM modem is a highly flexible plug and play quad band GSM modem
- For direct and as integration to TTL
- Supports features like Voice, Data/Fax, SMS,
- GPRS and integrated TCP/IP stack.
- Control via AT commands (GSM 07.07, 07.05and as enhanced AT commands)
- Use DC Power 3.6 - 4.6 Volts Maximum
- Current Consumption in normal operation 250mA can rise up to 1Amp while transmission.

6. A BRIEF INTRODUCTION OF AT COMMAND

The GSM modem and the controller are connected through RS232 serial ports. They communicate with AT commands. AT commands are a set of commands that has been standardized to communicate with terminal equipments such as modem, mobile phone as well as to control them. Most GSM modems support AT commands. A part of the code in virtual terminal is shown in the figure 2. The command set is quite elaborate. However, only a small part of it is related to SMS operations. The most frequently used Commands are:

AT+CMGS: To send a short message

AT+CMGR: To read a short message from the GSM module

AT+CMGL: To list SMS short messages stored in the GSM module

AT+CMGD: To delete a short message from the GSM module

AT+CNMI: Remind mode Setup when receive a new SMS

As the low-level function interface to the GSM modem, these commands play a fundamental role in the software developing of the gateway program.

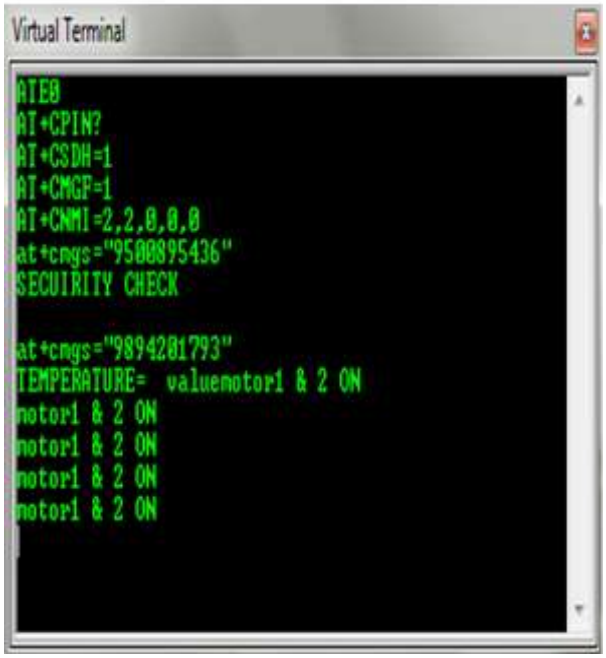

Fig 2 : Virtual Terminal Window showing AT command to SWITCH ON the motors

7. A BRIEF INTRODUCTION OF DEVELOPMENT TOOLS

7.1. MPLAB

The current version of MPLAB IDE is version 8.63. It is a 32-bit application on Microsoft Windows and includes several free software components for application development, hardware emulation and debugging. MPLAB IDE also serves as a single, unified graphical user interface for additional Microchip and third-party software and hardware development tools.

Both Assembly and C programming languages can be used with MPLAB IDE v8. Others may be supported through the use of third-party programs.

Support for MPLAB IDE, along with sample code, tutorials, and drivers can be found on Microchip's website. MPLAB IDE v8 does not support Linux, UNIX or Macintosh operating systems.

7.2. PROTEUS

Proteus is software for microprocessor simulation, schematic capture, and printed circuit board (PCB) design which is developed by Lab centre Electronics.

This tool is used to simulate the hardware as a working model which extensively supports the simulation environment and enables the user to create a model of the design which is about to get to the next level of the hardware designing. Since the project is being simulated even before the hardware implementation, these types of simulation tools avoid heavy loss of money and time. The PROTEUS development tool in particular with its extensive instruction sets helps easy implementation and a user friendly environment for developing the project.

The PROTEUS tool gives a platform on which the required design of the circuit could be made. In addition this tool has most of the architectures inside its in built library. So the user doesn't want to design the entire model of the project inside the simulating environment.

8. IMPLEMENTATION

The software for the system is developed in embedded C and the hex file is generated using MPLAB tool. The flow chart shows the monitoring and control of motors.

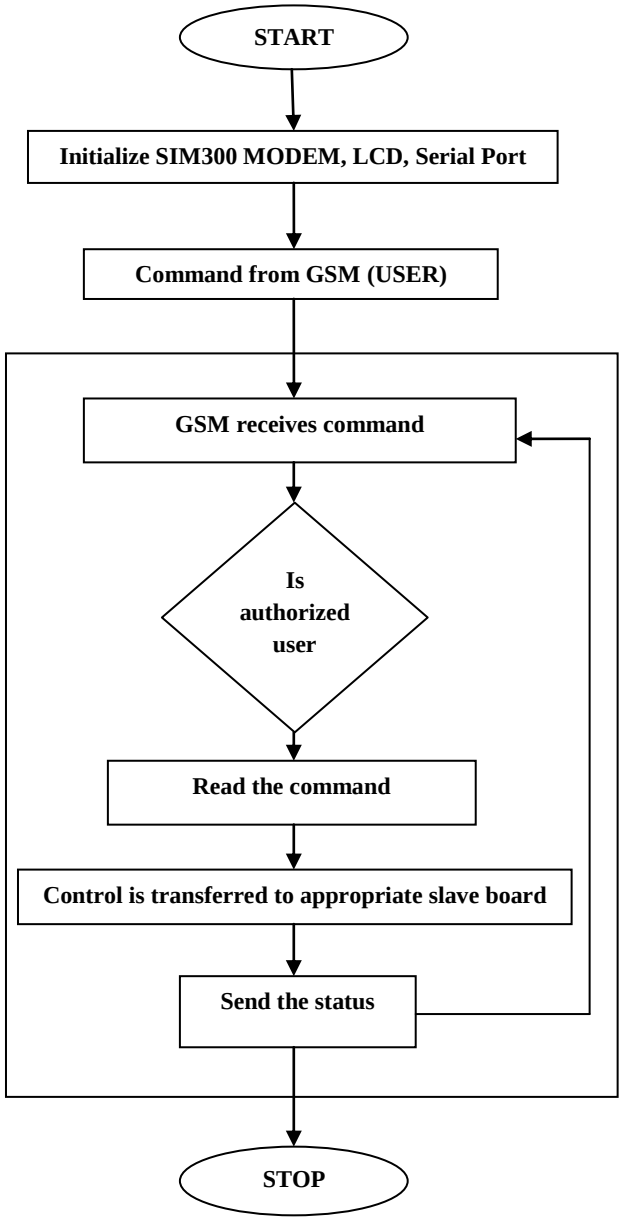

Fig 3: Flowchart

9. RESULTS AND DISCUSSION

Present paper is designed using PIC. It is proposed to design an embedded system which is used for controlling of multiple motors by using single GSM. In this paper PIC16F877A microcontroller is used for interfacing to various hardware peripherals. For doing so a PIC16F877A microcontroller is interfaced serially to a GSM Modem. An EEPROM is used to store the mobile number. The hardware interfaces to microcontroller are LCD display, GSM modem current transformer and voltage transformer. The design uses RS-232 protocol for serial communication between the modems and the microcontroller. A serial driver IC is used for converting TTL voltage levels to RS-232 voltage levels.

The simulation is carried out by using PROTEUS design tool. The current design is an embedded system platform, in which the code for controlling of motors is loaded into the controller.

The result shows that, it will work well for controlling of multiple motors at a time and responds immediately to the user's commands. In the old system, controlling of 8 motors achieved using relay drivers so there may be possibility for collision occurrence and controller used in that system does not have inbuilt ADC block so status cannot be received. To avoid this kind of problem we are going to implement this paper by which we can achieve our goals.

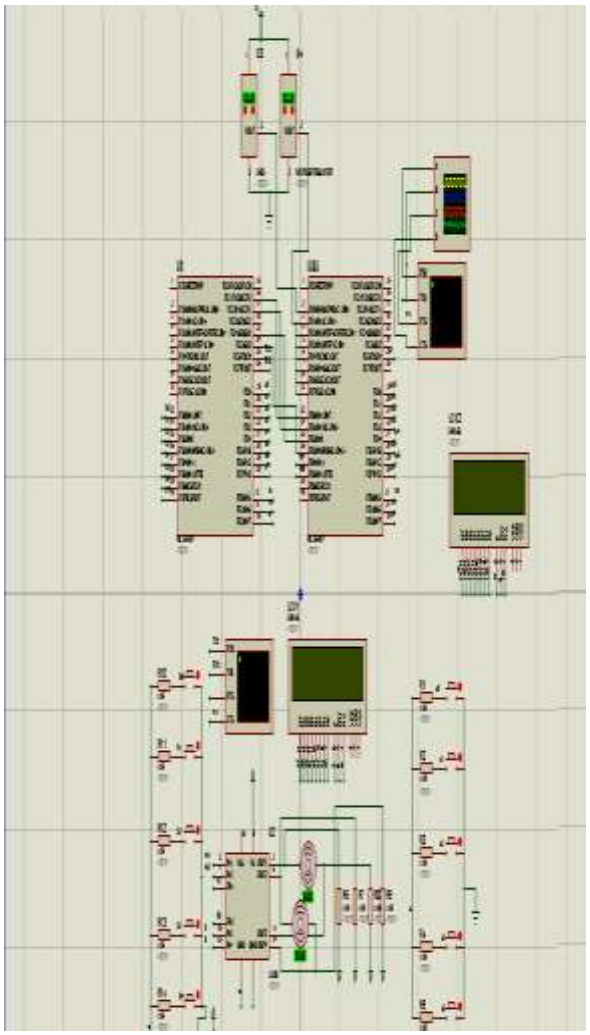

Fig 4: Simulation Results

10. CONCLUSION

In this paper low cost, secure, ubiquitously accessible, auto-configurable, remotely controlled solution for automation of different motors has been introduced. The approach discussed in the paper has achieved the target to control multiple motors remotely using the GSM -based system satisfying user needs and requirements.GSM technology capable solution has proved to be controlled remotely, provide industrial security and has achieved the target to control multiple motors using the SMS-based system in order to provide industrial security and is cost-effective. Hence we can conclude that the required goals and objectives of GSM based motor monitoring and control has been achieved.

11. REFERENCES

[1] Holemuke, R.M., Kadam, A.M, Shinde, P.R., Wanhkhede, S.M, "Microcontroller based control of three phase induction motor using PWM technique",978-1-4244-9567-2/11/11,2011-IEEE

[2] Nano Ganesh "Remote control irrigation pump operator cell phone based control of irrigation pump using call basedtechnique"-2011

[3] Ahmed, V, Ladhake, S.A, "Design of ultra-low cost cell phone based embedded system for irrigation machine vision and human-machine interface" 2010-ISBN: 978-1-4244-6595.8

[4] Bagade, A.P,Haridas, S.L, Indurkar,P.R "Development of a mobile based device remote control with voice acknowledgement" NCIPET-2012

[5] Bhaskar V,Gowrimanohar,T "GSM based motor monitoring and speed control"-IJMIE,ISSN NO,2231-6477,Volume 1,issue-2,2011

[6] Ahmed, V, Ladhake, S.A. "Innovative Cost Effective Approach for Cell Phone Based Remote Controlled Embedded System for Irrigation", Communication Systems and Network Technologies (CSNT), 2011

[7] Mouton, A.J.J. , Tshwane Univ. of Technol., Tshwane, South Africa , Smith, G.E. " Effective remote control of electric motors using GSM technology", IEEE Conference onEmerging Technologies & Factory Automation ,2009. E-ISBN: 978-1-4244-2728-4

[8] Mghawish, A, Dept. of CSC, Alzaytoonah Univ. of Jordan, Amman, Jordan, AbdelQader, A.A. , Al-Jezawi, M.A. , Abu Mahfouz, M. " Multi-function control system using GSM modem based SM5100B Module" 2012 International Conference for Internet Technology And Secured Transactions

[9] DanielN.Lewis,"Run of embedded software "Pearson education-2001 embedded/real-time system: Concepts, design and programming" Dream technology, Wiley, 2003